

Owens Tui Chub (*Siphateles bicolor snyderi* = *Gila bicolor snyderi*)

Legal Status

State: Endangered,
Fully Protected

Federal: Endangered

Critical Habitat: Designated on August 5, 1985 (50 FR 31592–31597)

Recovery Planning: Owens Basin Wetland and Aquatic Species
Recovery Plan, Inyo and Mono Counties (USFWS 1998)

Notes: The 5-year review for this species (USFWS 2009) found that threats that were present when the Owens tui chub was listed are still present with new threats identified. The recovery priority number assigned was 3, which indicates the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery (USFWS 2009).



Photo courtesy of Joe Ferreira

Taxonomy

The Owens tui chub (*Siphateles bicolor snyderi*) is a member of the minnow family (*Cyprinidae*). It was described in 1973 as a subspecies of tui chub endemic to the Owens Basin (Miller 1973) as *Gila bicolor snyderi*. Simons and Mayden (1998) published a paper addressing the classification of the North America genera of *Cyprinidae* and, based on ribonucleic acid sequences, restored *Siphateles* from a subgenus to a full genus. The California Department of Fish and Game (CDFG) currently includes the species under the genus *Siphateles* (CDFG 2011), and the U.S. Fish and Wildlife Service (USFWS) proposes the scientific name change from *G. b. snyderi* to *S. b. snyderi* (USFWS 2009). This name change will not affect its federal listing status.

It is morphologically similar to the Mohave tui chub (*S. b. mohavensis*) and Lahontan tui chub (*S. b. obesus*). It is distinguished from its closest relative, the Lahontan tui chub, by scales with a weakly developed or absent basal shield, lateral and apical radii that number 13 to 29, the

structure of its pharyngeal arches, the number of anal fin rays, gill-raker counts of 10 to 14, and 52 to 58 lateral line scales (Miller 1973). Dorsal and lateral coloration varies from bronze to dusky green, grading to silver or white on the belly. The species may reach a total length of 12 inches. The Owens tui chub evolved in the Owens River watershed with only three other smaller species of fishes, Owens pupfish (*Cyprinodon radiosus*), Owens speckled dace (*Rhinichthys osculus* ssp.), and Owens sucker (*Catostomus fumeiventris*) (USFWS 2009).

Based on recent genetic research, Chen et al. (2007) proposed that the Cabin Bar Ranch population is a separate lineage—the Toikona tui chub lineage—from the Owens tui chub lineage. They do not propose making a formal taxonomic split from the Owens tui chub until more information becomes available.

Descriptions of the species' physical characteristics can be found in USFWS (1998) and USFWS (2009).

Distribution

General

The Owens tui chub is endemic to the Owens Basin (Owens Valley, Round Valley, and Long Valley) of Inyo and Mono Counties, California (CDFW 2013; USFWS 1998).

Distribution and Occurrences within the Plan Area

Historical

Early fish collections in the Owens Basin documented Owens tui chub in Owens Lake, several sites along the Owens River from Long Valley to Lone Pine, tributary streams near the Owens River in Long Valley and Owens Valley, Fish Slough, and irrigation ditches and ponds near Bishop, Big Pine, and Lone Pine (Miller 1973; USFWS 2009). Although there are only two historical (i.e., pre-1990) records for Owens tui chub in the Plan Area in the California Natural Diversity Database (CNDDB) (Figure SP-F04) (CDFW 2013; Dudek 2013), the scattered distribution of these localities and the ease with which researchers captured fish suggest that

Owens tui chub were common and occupied all valley floor wetlands near the Owens River in Inyo and Mono counties (USFWS 2004).

Recent

Currently, genetically pure Owens tui chub is limited to six isolated sites in the Owens Basin: Hot Creek Headwaters (AB Spring and CD Spring), Little Hot Creek Pond, Upper Owens Gorge, Mule Spring, White Mountain Research Station (operated by the University of California), and Sotcher Lake, the last of which is outside the historical range of the species in Madera County (USFWS 2009). However, there are only three recent occurrence records documented in the CNDDB database (Figure SP-F04; CDFW 2013; Dudek 2013). In 1987, Owens tui chub were found occupying irrigation ditches and a spring at Cabin Bar Ranch on the southwest shore of Owens Dry Lake, and became known as the Cabin Bar Ranch population (USFWS 2009). Predation from introduced largemouth bass (*Micropterus salmoides*) and bluegill sunfish (*Lepomis macrochirus*), and failure to maintain adequate water quality and quantity, extirpated the Cabin Bar Ranch population of Owens tui chub in 2003 (USFWS 2009). However, prior to extirpation, 24 individuals were placed in an artificial pond and moved to Mule Spring in 1990; all extant fish of this group descend from this transplant (Chen et al. 2007). The Plan Area only includes the former Cabin Bar Ranch population, with the Mule Spring population (see Figure SP-F04) adjacent and outside of the Plan Area boundary. USFWS (1998) has proposed two conservation areas within the Plan Area: Black Rock and Southern Owens Dry Lake (the Cabin Bar Ranch population was found on the southwest shore of Owens Dry Lake).

Natural History

Habitat Requirements

The Owens tui chub occurs in low-velocity waters with well-developed beds of aquatic plants, rocks, and undercut banks with bottoms of gravel (Leunda et al. 2005; Moyle 2002). Dense aquatic vegetative cover is likely important to Owens tui chubs for predator avoidance, reproduction, water velocity displacement, and feeding (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Plant

species observed in occupied habitat at the Hot Creek Headwaters population include watercress (*Nasturtium officinale*), water fern (*Azolla filiculoides*), duckweed (*Lemna* sp.), pondweed (*Potamogeton* sp.), aquatic buttercup (*Ranunculus aquatilis*), and elodea (*Elodea canadensis*) (McEwan 1991). McEwan (1991) provides details of the habitat structure at the Hot Creek Headwaters population, where plants cover approximately 50% to 75% of the stream surface area. The plants typically grow out from the sides in the main channel, forming dense beds along the stream margins that delineate a small chute of swift-flowing water in the center of the channel. In the backwater areas with zero water velocities, vegetation covers nearly 100% of the surface area. There is a limited die-off of vegetation beds during the winter, but most of the beds persist due to the thermal characteristics of the headsprings.

Water temperature within occupied habitat varies to a great degree (as summarized in Geologica [2003]). It can be fairly constant at spring sites (14–18°C [57–64°F]), hotter at hot springs (21–25 °C [70–77°F]), and cooler in a river (36–78°F [2–25°C]) (Geologica 2003). Within occupied habitat where measurements exist, pH ranges from 6.6 to 8.9 (McEwan 1989; Geologica 2003), dissolved oxygen varies from 5 to 9.3 milligrams/liter (Malengo 1999; Geologica 2003), and alkalinity varies from 68.0 to 88.4 parts per million (McEwan 1989).

The Owens tui chub is restricted to six total populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in manmade ponds at upland sites with water supplied by artificial methods. A detailed account of the habitat at each of the extant populations can be found in the 5-year review (USFWS 2009).

Table 1. Habitat Associations for Owens Tui Chub

Land Cover Type	Land Cover Use	Habitat Designation	Habitat Parameters	Supporting Information
Low-velocity waters	Breeding /foraging	Primary	Low-velocity waters with well-developed beds of aquatic vegetation, rocks, and undercut banks	Direct observation studies

Sources: USFWS 2009; Leunda et al. 2005; McEwan 1991, Geologica 2003.

Foraging Requirements

The results of a gut content analysis indicate that Owens tui chub is an opportunistic omnivore that utilizes a wide variety of food items (McEwan 1991). Aquatic vegetation is especially important as it provides forage and habitat for aquatic invertebrates, the main food item of the Owens tui chub (McEwan 1989, as cited in Geologica 2003; McEwan 1991). Specific food items that appear to be of importance include chironomids, larvae of two species of hydroptillid caddisfly, other aquatic invertebrates, plant material, and detritus (McEwan 1991). There is evidence that the diet varies seasonally at the Hot Creek Headwaters (McEwan 1991); the dominant items in Owens tui chub diet there are chironomid larvae and algae in spring, chironomid larvae in summer, hydroptillid caddisflies in fall, and chironomid larvae in winter (McEwan 1991). Owens tui chubs feed mainly by gleaning and grazing among submerged vegetation (Geologica 2003).

Reproduction

Sexual maturity in Owens tui chub appears dependent on the microhabitat. For example, sexual maturity in springs with constant water temperature has been recorded at 2 years for females and 1 year for males, in comparison to more varied temperatures where males and females reach sexual maturity at 2 years (McEwan 1990, as cited in USFWS 2009). In general, tui chubs congregate from later winter to early summer to spawn over aquatic vegetation or gravel substrates (Kimsey 1954, as cited in Geologica 2003). More

specifically, McEwan (1990, as cited in USFWS 2009), recorded spawning from late winter to early summer at spring habitats, and from spring to early summer in riverine and lacustrine or lake-like habitats. Spawning appears to be triggered by day length and warming water temperatures (McEwan 1989, 1990, as cited in USFWS 2009). With the adhesive quality of the eggs, spawning usually occurs over gravel substrate or aquatic vegetation (USFWS 2009). Multiple spawning bouts during the breeding season are likely (Moyle 2002), and females may produce large numbers of eggs at each bout (Geologica 2003). Embryos hatch in 3 to 6 days (Moyle 2002), and may be influenced by water temperature, with eggs hatching earlier in warmer water (Cooper 1978, as cited in USFWS 2009). Larvae remain near aquatic plants after hatching (Moyle 2002). Growth during the first summer is rapid and slows at maturity, usually in the second to fourth year (Moyle 2002).

Table 2. Key Seasonal Periods for Owens Tui Chub

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Breeding			X	X	X	X	X					

Sources: USFWS 1998, 2009.

Spatial Activity

The dispersal, home range, and migratory patterns of Owens tui chub are not well understood. Many of the locations where they are currently found are completely isolated from other populations. Tui chubs congregate from late winter to early summer to spawn over aquatic vegetation or gravel substrates (USFWS 2009). Chen et al. (2007) have determined that the Owens tui chub lineage is more genetically distinct from the Cabin Bar Ranch population (the Toikona tui chub lineage) than the Lahontan tui chub, which may represent independent lines of evolution (i.e., no dispersal). Morphology, swimming ability, and behavior all suggest the species is not adapted to movement through rapid waters (Moyle 2002). Therefore, movement of this species likely requires the presence of vegetation beds so that high-velocity areas are encountered only briefly. Jenkins (1990, as cited in Geologica 2003) observed no Owens tui chub in the Owens River

Gorge within riffle habitat. Dispersal of other species of tui chub has been inferred using gene flow, where unidirectional dispersal and bidirectional inter-basin gene flow have been recorded (Chen 2006). In addition, daily migrations have been observed for tui chub in large, deep lakes during summer, whereas they move between deep water during the day and shallow water during the night (Moyle 2002).

Ecological Relationships

Owens tui chub were once common and occupied all valley floor wetlands near the Owens River in Inyo and Mono counties. Since that time, predaceous non-native fishes, extensive development of water resources, and interbreeding with Lahontan tui chub has resulted in population decline and habitat loss.

Currently, the major threat to the species is introgression with Lahontan tui chub (Chen et al. 2007). The Owens tui chub is reliant on slow-moving freshwater habitats that provide food and cover, but that are free of non-native aquatic predators and other tui chub subspecies and hybrids. It requires aquatic vegetation for cover, foraging, and spawning, as well as gravel substrates for spawning. If one or more of these elements are absent, it can be quickly extirpated from a location.

Population Status and Trends

Global: Critically imperiled (NatureServe 2011)

State: Same as above

Within Plan Area: Same as above

Since its listing in 1985, three new populations of Owens tui chub have been established, bringing the current number to six. Four of these populations are in small, manmade or man-altered waters, and one is outside the historical range of the species at an artificial lake (Sotcher Lake). USFWS (2009) recommends that a Recovery Priority Number of 3 be assigned to Owens tui chub, which indicates that the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery. The threats that were present when the Owens tui chub was listed are still present with new threats identified (USFWS 2009).

Threats and Environmental Stressors

USFWS (2009) provides a detailed explanation of the threats to Owens tui chub, which are summarized here. Currently, the major threat to the species is introgression (i.e., hybridization) with Lahontan tui chub (Chen et al. 2007), which has resulted in extirpation throughout most of its range (USFWS 2009). In 1973, the Lahontan tui chub was introduced as baitfish into many of the streams in the Owens Basin. Historically, the Owens tui chub and Lahontan tui chub were isolated from each other, but now hybridization has been documented for populations in Mono County—at Hot Creek (downstream from the hatchery), Mammoth Creek, Twin Lakes–Mammoth, June Lake, and Owens River Upper Gorge Tailbay. In Inyo County, hybridization has been documented at A1 Drain, C2 Ditch, and McNally Canal (Madoz et al. 2005, as cited in USFWS 2009; Chen 2006, as cited in USFWS 2009). If the barriers that are acting to isolate the Owens tui chub populations from Lahontan tui chub become permeable, this could result in the loss of genetically pure populations of Owens tui chubs at Hot Creek Headwaters, Little Hot Creek Pond, and the Upper Owens Gorge. In addition, the opportunities to establish new populations of Owens tui chub in the Owens Basin are limited by the presence of hybrids in the Owens River and its tributaries. Currently, the only viable locations for establishing the Owens tui chub are isolated springs or the headwaters of streams with downstream barriers to upstream movement of Lahontan tui chubs or hybrids.

USFWS (50 FR 31592–31597) identified extensive habitat destruction and modification as threats to the Owens tui chub, and this is current as of today. Currently, Owens Basin water is in high demand that is expected to increase, which would reduce the overall availability of surface waters. The survival of two populations (White Mountain Research Station and Mule Spring) is dependent upon the continual maintenance of the artificial water supply and assurance of adequate water quality. The Upper Owens Gorge population is a pool created by a beaver dam that is eroding, which is slowly reducing the lacustrine habitat for Owens tui chubs.

Submerged aquatic vegetation is a key habitat requirement for the Owens tui chub, but not with large amounts of emergent vegetation because it may provide cover for nonnative predators of Owens tui

chubs, such as bullfrogs and crayfish (*Procambarus* sp.). At the spring sites (Hot Creek Headwaters, Little Hot Creek Pond, and Mule Spring), emergent vegetation (e.g., cattail) have reduced and altered the aquatic habitat, and routine removal of emergent vegetation is required. The Mule Spring and White Mountain Research Station populations require routine management of water quantity and water quality. The environment that the Upper Owens Gorge population inhabits has been severely altered by the construction of a dam, with no mechanism to manage adequate releases of water downstream of the dam.

Since listing, evidence of disease has been observed in some populations of the Owens tui chub (USFWS 2009). In AB Spring at Hot Creek Headwaters, Bogan et al. (2002, as cited in USFWS 2009) found evidence of infection in six of the seven Owens tui chubs that were collected for genetic analysis. Since disease has been identified in Owens tui chubs, it is considered a threat. However, the magnitude of this threat is unknown (USFWS 2009).

The final listing rule (50 FR 31592–31597) identified predation by introduced non-native fish as a major threat to the Owens tui chub. Predation by non-native largemouth bass and brown trout is thought to have eliminated Owens tui chubs from much of their historical range in the Owens River (Chen and May 2003), and it is believed that non-native fish (largemouth bass and bluegill sunfish) played a role in extirpating the Cabin Bar Ranch population (Chen et al. 2007). Mosquito fish (*Gambusia affinis*) may also present a threat, as they are known to prey on small individuals of Mohave tui chub (Archdeacon 2007, as cited in USFWS 2009). At Mule Spring, bullfrogs are present and probably prey on Owens tui chubs, as they are known to prey on other subspecies of tui chubs (Parmenter 2006, as cited in USFWS 2009).

The inadequacy of existing regulatory mechanisms is considered a threat at this time by USFWS (2009), largely due to unregulated actions that could overdraft the aquifer in the Owens Valley Groundwater Basin area, which may result in reduced or no water flow to existing isolated springs and headwater springs of streams in the Owens Basin. The issue stems from the fact that the aquifer in the Owens Basin has not been adjudicated and its use is not regulated. Any reduction in flow from springs in the Owens Basin would result in

further reductions of habitat quality and quantity for the Owens tui chub at springs and tributaries of the Owens River.

Currently, Owens tui chub populations are small, between 100 and 10,000 individuals; therefore, random events that may cause high mortality or decreased reproduction could readily eliminate an entire population, which would have a significant effect on the viability of Owens tui chub populations. Furthermore, because the number of populations is small (six) and each is vulnerable to this threat, the risk of extinction is exacerbated (USFWS 2009). The Owens tui chub has experienced population loss from environmental stochastic events and will likely do so in the future. For example, the Cabin Bar Ranch population was lost because of an apparent failure to maintain adequate water quality and quantity and the introduction of non-native predators. Another example is the disappearance of Owens tui chub from the Owens Valley Native Fishes Sanctuary (Fish Slough). Reasons for the loss of this population are not known, but the small, isolated nature of this population likely contributed to their extirpation (USFWS 2009).

In small populations, such as the Owens tui chub, there are a number of factors that may reduce the amount of genetic diversity retained within populations and may increase the chance that deleterious recessive genes are expressed. Loss of diversity could limit the species' ability to adapt to future environmental changes and contributes to inbreeding depression (i.e., loss of reproductive fitness and vigor) (USFWS 2009). Deleterious recessive genes could reduce the viability and reproductive success of individuals. Isolation of the six remaining populations, preventing any natural genetic exchange, will lead to a decrease in genetic diversity.

Conservation and Management Activities

The recovery plan (USFWS 1998) provides a detailed account of management goals that need to be successfully implemented in order for the species to be delisted:

- Establish multiple, self-sustaining populations of Owens tui chubs throughout much of the historical range of the species in six identified conservation areas;

- Ensure these populations are self-sustaining;
- Ensure that each population contains juvenile and three additional age classes, and that the biomass of Owens tui chubs exceed the biomass of deleterious, non-native aquatic predatory species, which would demonstrate successful recruitment and minimal predation on smaller Owens tui chubs by non-native aquatic species;
- Reduce competition with non-native aquatic species;
- Increase the ability to conserve and protect aquatic habitats;
- Implement measures to prevent hybridization with introduced Lahontan tui chubs;
- To the extent possible, reduce the probability of the loss of Owens tui chub populations from stochastic events; and
- Complete an approved management plan and implementing agreement that address water quantity and groundwater management with the land managers.

These recovery plan criteria do not address threats from disease; catastrophic events that may affect the Owens Basin; demographic, genetic, or environmental stochasticity; or climate change. The recovery plan identifies no recovery criteria for the Toikona lineage, as the occurrence of this lineage was unknown when the recovery plan was approved. The 5-year review (USFWS 2009) finds that none of these management goals has either not been achieved or can't be evaluated.

Data Characterization

The distribution of and threats to Owens tui chub are sufficiently well known to allow coverage of this species in the Desert Renewable Energy Conservation Plan. Missing pieces of information on this species include the lack of understanding of the Toikona lineage as far as origin, genetics, and ecophysiology (Chen et al. 2007). Additionally, the lack of management plans at each of the six existing populations has resulted in less than ideal protections for the species and a poor understanding of the population dynamics. A reintroduction plan with a specific genetic distribution of the current populations is also needed. Considering the degree of known

introgression between Lahontan and Owens tui chub (Chen et al. 2007), data on the distribution of genetically pure Owens tui chub and existing barriers is key.

Management and Monitoring Considerations

The Plan Area includes the former Cabin Bar Ranch population at Southern Owens Dry Lake. The Mule Spring population is the closest extant population, which occurs about 2 miles outside the Plan Area boundary. There are also two proposed conservation areas in the Plan Area: Black Rock and Southern Owens Dry Lake. The genetically important and distinct Toikona lineage that occurs at Mule Spring descended from a total of 24 founders from Cabin Bar Ranch and its extant population is confined to two diminutive artificial ponds at Mule Spring (Chen et al. 2007). Chen et al. (2007) have determined that the Owens tui chub lineage is more genetically distinct from the Toikona lineage than the Lahontan tui chub, which illustrates the genetic importance of the Toikona lineage. They have also determined that the Toikona lineage is suffering from low genetic variation that may be a consequence of founder effects. Specific management within the Plan Area may include development of a management plan specific to the Mule Spring population. The management plan should propose methods to secure the conservation and the management of water quantity, water quality, habitat, and aquatic predators at the existing occupied ponds at Mule Spring. It should also illustrate in detail how to create new populations for the Toikona lineage, as well as increase effective population size. This detail should include a specific standardized genetic protocol. Candidate conservation areas to be evaluated within the Plan Area for new Toikona lineage populations may include Black Rock and Southern Owens Dry Lake. Evaluation criteria may include the presence of suitable habitat and the absence of predators and the Lahontan tui chub and their hybrids. Because so little is known about the Toikona lineage, additional studies and research should be proposed, such as origin, genetics, and ecophysiology.

Species Modeled Habitat Distribution

This section provides the results of habitat modeling for Owens tui chub, using available spatial information and occurrence information, as appropriate. For this reason, the term “modeled suitable habitat” is used in this section to distinguish modeled habitat from the habitat information provided in Habitat Requirements, which may include additional habitat and/or microhabitat factors that are important for species occupation, but for which information is not available for habitat modeling.

There are 17,384 acres of modeled suitable habitat for Owens tui chub in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

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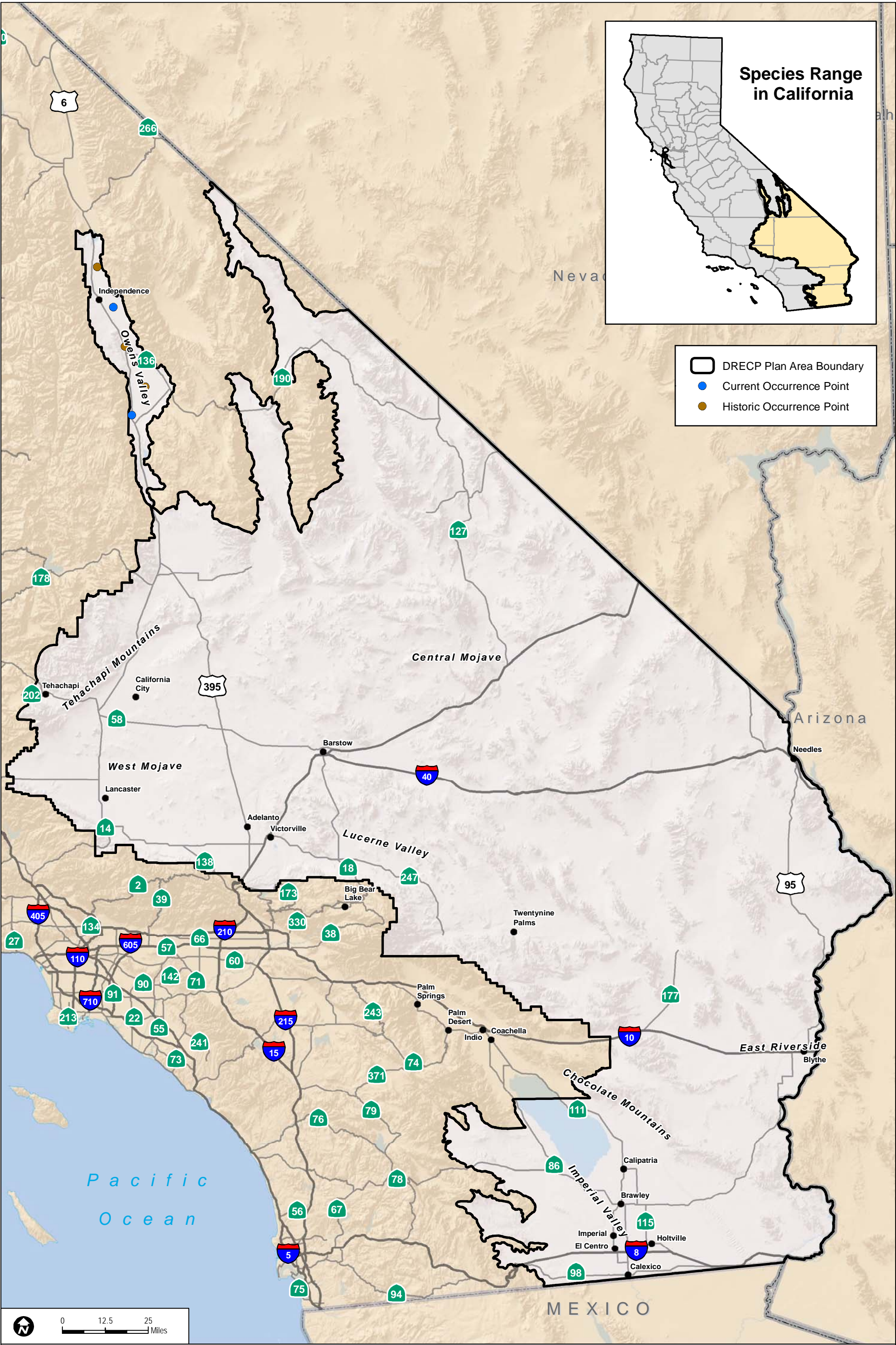
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Owens Tui Chub (*Siphateles bicolor snyderi*)

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Sources: ESRI (2014); DRECP Species Occurrence Database (2013), CWHR (2008)

FIGURE SP-F04
Owen's Tui Chub Occurrences in the Plan Area